EnerOptions

Introducing ENEROPTIONS:

This ENEROPTIONS file folder contains a series of case studies on demonstrations of energy conservation and renewable energy technologies directly applicable to the **Forest Products Industry**. Each case study outlines the benefits, costs, payback period and nature of the demonstration as well as the operating experience, technical details, supplier information and appropriate applications of the particular technology. These case studies provide sufficient real-life information for you to assess whether the technology is applicable to your own situation. Contact people to assist you in this process or in actual implementation of the technology are listed at the end of each case study.

You will also find an overview paper entitled **INDUSTRIAL — Forest Products** in this ENEROPTIONS file folder. This overview paper integrates the collective experience of project managers, technical experts and government officials involved in the various demonstrations that are applicable to this sector. The paper draws together the vital lessons learned from these demonstrations — lessons that will greatly benefit future users of the technology. In addition, the overview paper recommends certain steps that should be taken in applying these technologies to your situation.

This ENEROPTIONS file folder provides a convenient method of storing and retrieving information on energy conservation and renewable energy options relevant to your business. Use it to file the ENEROPTIONS materials as well as other energy-related information you obtain. All ENEROPTIONS materials can be photocopied and passed on to other interested parties. Additional file folders on a range of subjects are also available free of charge.

ENEROPTIONS provides you with the results of successful technologies and techniques demonstrated under the Conservation and Renewable Energy Demonstration Agreements (CREDA) Program. ENEROPTIONS is funded by the energy departments of Canada, New Brunswick, Newfoundland, Manitoba, The Northwest Territories, and The Yukon.

EnerOptions

OVERVIEW PAPER

INDUSTRIAL SECTOR-

Forest Products

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OVERVIEW PAPER

INDUSTRIAL SECTOR–

Forest Products

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INDUSTRIAL SECTOR -
Forest products

1. INTRODUCTION

With the rising price of oil and other fuels and the availability of modern chipping, handling and combustion equipment, wood residues are coming to be regarded by forest products companies as a valuable by-product. Either on their own or in combination with mill wastes, these residues are leading to a new line of business for forest companies--the supply of wood fuel to various local users. The major new sources of wood residues are wood harvesting and non-marketable timber. Previously, both of these residues were left in the forest or had to be cleared away at a substantial cost to make way for reforestation.

Lessons valuable to any business considering going into wood fuel supply can be learned from projects assisted by the Federal/Provincial Conservation and Renewable Energy Demonstration Agreements (CREDA) program which investigated the creation of an infrastructure to supply this new fuel. Further initiatives to establish wood residue as a fuel supply should be guided by the lessons learned from these demonstrations and should take advantage of the resources now available to facilitate implementation.

2. CREDA DEMONSTRATIONS

Four CREDA supported projects investigated the potential for the establishment of a wood energy supply industry. Although all four projects are located on the east coast they provide valuable examples for operations established in other provinces. A detailed description of each project is provided in the ENEROPTIONS Case Studies attached. A brief outline of each of them is provided below.

NFLD 12 Whole Tree Chipping for Fuel - Abitibi Price, Grand Falls, Newfoundland

This project demonstrated and evaluated a complete harvesting -chipping-transportation system for the burning of hardwoods as an alternative to Bunker C oil in a pulp and paper mill. A saving of $86,000 was achieved by replacing 16,071 barrels of oil with wood chips.

NFLD 23 Fuelwood Supply Evaluation - Bonavista Peninsula, Newfoundland

This study assessed the supply of fuelwood -- both mill residue and forest biomass -- in the Bonavista Penninsula of Newfoundland and established the production cost of wood chips. The study concluded that the projected demand for wood chips would be 15,000 green tonnes (16,535 tons) of chips per year which could be met at a cost of $27.40 per green tonne ($24.85 per ton) or $49.81 per dried tonne ($45.18 per ton).

NB 59 + 78 Wood Supply Infrastructure--New Brunswick

These two studies examined the supply and demand for wood fuel derived from logging residues and the opportunities for the establishment of a wood energy supply industry. Findings indicated that various institutions and industries could support the establishment of businesses supplying wood chips, sawmill residue, and roundwood (semi-processd wood fuels) at an attractive return on investment.

NB 68 Harvesting Forest Residue - Repap Miramichi Forest Products, Newcastle, New Brunswick

This project involved the clear cutting of 135 hectares (334 acres) of low quality timber stands. Once marketable wood was removed, all remaining trees and cuttings were chipped on-site using a mobile chipper, forwarder and chip bin and then trans-

ported 16 km (10 mi) to a pulp mill for use as hog fuel. Annual savings of over $190,000 were realized from the use of the wood chips and reductions of $13,500 were achieved in preparation costs for the site prior to replanting.

The viability of the demand side of wood energy has been proven. The ENEROPTIONS Wood Burning package describes projects which create a market for wood residue, including projects financed from savings alone and installed on a turnkey basis.

3. LESSONS LEARNED

Competitive Position. The harvesting, processing and transportation of forest residues can be performed at a delivered cost that is lower than the cost of oil and electricity used for heat. In some cases, wood residue is competitive with the market value of hog fuel from mills. A critical factor affecting the delivered cost, however, is the trucking distance from site to point of use. Using equipment currently available, any distance over 100 km begins to render forest residue uncompetitive.

Hidden Economic Benefits. There are significant hidden advantages to the harvesting of forest residues. In some cases, the value of the residues makes the cutting of merchantable trees economic on a stand of trees that would otherwise be uneconomic to harvest. In other cases, the use and sale of non-merchantable trees and scrub subsidizes the cost of clearing and preparing the site for reforestation.

Delivered Cost. Green wood chips can be delivered at a cost of between $20 and $30 per tonne ($18 to $27 per ton) depending on equipment reliability and the value placed on clearing land for reforestation.

Chipper Efficiency. It was found that production increased if the mobile chipper was kept at the roadside and was fed by a forwarder rather than bringing the chipper into the forest. Another method of improving efficiency of the chipper is to use chip storage bins which allow for

Chipper Efficiency. It was found that production increased if the mobile chipper was kept at the roadside and was fed by a forwarder rather than bringing the chipper into the forest. Another method of improving efficiency of the chipper is to use chip storage bins which allow for continuous operation of the chipper while the truck is away on delivery. Several factors contribute to decreased chipper efficiency. Logs pick up considerable amounts of soil and rock during skidding which leads to increased jamming and maintenance of the chipper. Similarly, chopping during wet or snowy weather was more difficult due to much higher moisture content in the forest residue.

Supply and Demand. Any potential wood fuel supply business should be preceded by a thorough assessment of sources of supply and markets within the subject region. Potential markets for wood fuel include most industrial, commercial and institutional establishments currently using oil or electricity to produce steam or low-temperature heat. Special consideration should be given to medium-sized industries of various types: schools, hospitals, prisons, greenhouses, nursing homes and district heating plants. A separate market for cordwood or, in certain circumstances, wood-chips, may exist among residential users. It appears the most attractive business opportunities are:

- wood-chip supply (green wood-chips from forest residues)
- sawmill residue supply (bark and sawdust)
- fuelwood supply (cordwood in various lengths from 2.4 m (8 ft) to 4.9 m (16 ft) mostly for the residential sector)

There are major and profitable opportunities for new businesses and for the extension of traditional forest industries into wood fuel supply.

Supply assessments should examine the full range of sources from forest residues to waste from wood products. In most cases studied to date, wood fuel can supply a significant portion of local oil and electrical needs (10% to 30%) and use only a portion of the available economic supply of wood residue (from 29% to 50%).

Infrastructure Needs. Past experience has demonstrated a need for vertical integration of the wood residue supply industry. Specifically, suppliers of wood fuel should also provide analysis, advice and instal-

lation of handling and combustion equipment so that the buyer is able to obtain a complete service from one company.

4. NEXT STEPS

If you are considering supplying wood residue for use as a fuel as described in the materials presented in this and the Wood Burning ENEROPTIONS packages, you should consider the "next steps" suggested below.

- read the case studies enclosed and obtain background technical reports on each

- undertake a survey of the market for wood fuel

- investigate the availability of wood residue supply including:

  - forest residues (unmarketable species, damaged stands, remote stands, harvesting residue)
  - residues from saw and lumber mills
  - pulp mill residues
  - waste from wood products industries (e.g., furniture, veneer)

- perform an economic analysis of business viability

5. RESOURCES AVAILABLE

Technical reports are available free of charge for most of the CREDA projects listed above. Addresses of appropriate contacts for follow-up, including equipment suppliers and system designers, are listed at the end of each of the attached ENEROPTIONS Case Studies under the "Further Information" section.

The Conservation and Renewable Energy Offices (CREOs) of Energy, Mines and Resources (EMR) Canada in each province and territory have information on

federal demonstrations and other assistance programs. Check the back of the attached file folder to locate the CREO in your area.

The departments or ministries of energy in each province or territory have information on energy conservation and alternative energy and may have assistance programs. Check your telephone directory for appropriate contact people.

The Task Force on Forest Products is another source of information, available through:

Task Force Programs
(Re: ENEROPTIONS)
Industrial Energy Division
Energy Conservation and Oil Substitution Branch
Energy, Mines and Resources Canada
580 Booth Street
Ottawa, Ontario
K1A 0E4
(613) 995-9447

ENEROPTIONS CASE STUDY

NB 68

Harvesting Forest Residue

REPAP MIRAMICHI FOREST PRODUCTS

Technology:
Combining the harvesting of pulpwood and non-commercial or below-grade timber.

Demonstration Project Manager:
Mr. Jan Ellingsen
Repap Miramichi Forest Products
P.O. Box 5040
Newcastle, New Brunswick
E1V 3N3

Location:
Newcastle, New Brunswick

Annual Savings: $190,240
$23.78 per tonne of wood chips used plus $13,500 in site preparation costs

Payback Period: 1.2 years

Applicable to: Forest products industries

Description:

By integrating the harvesting of pulpwood and non-commercial timber, the Repap Miramichi Forest Products (formerly Boise Cascade Canada Ltd.) pulp and paper mill at Newcastle, N.B., was able to clear-cut and replant a tract of forest that would not otherwise have been economical to cut at all. This was achieved because of both added revenues from the hog fuel provided by the wood residues and reduced costs from savings in site preparation for reforestation.

On a 135 hectare (334 acre) tract located 16 km (10 mi) from the pulpmill, the merchantable trees were cut and delivered to the pulpmill and local sawmills. The remaining trees were then felled, and a mobile chipper was brought in to process the trees and other logging residues. To maximize productivity, chipping took place at the roadside where a brush forwarder had collected the wood into piles. The chipped material was trucked to the mill to be burnt. The harvest site was then planted with softwood which will provide a higher yield in a shorter time and without additional site preparation costs.

Repap Miramichi has continued to use integrated harvesting and is pleased with the results.

Benefits:

- Use of forest residues in the form of chips replaced 500,000 litres (110,000 gals) of Bunker C oil, resulting in a cost savings of $190,240 or $23.78 per tonne ($21.57 per ton) of wood chips.
- Savings of $13,500 ($100 per hectare) were realized in the cost of preparing the site to be replanted with high quality softwoods.
- Eleven permanent jobs were created in connection with harvesting, chipping and transportation.
- Wood costs for the pulp and paper mill have been minimized by the harvesting of high quality pulpwood close to the mill. Planting of new trees will ensure a continued supply of good quality, low-cost wood close to the mill.
- Maximum use of soil capacity with respect to harvesting of available biomass.

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Performance:

Over a period of 8 months, 135 hectares (334 acres) of low-volume stands were cleared with a yield of 8,000 tonnes (8,818 tons) of hog fuel and 6,539 m^3 solid (230,900 ft^3) of pulpwood and sawlogs. Total marketable volume per hectare was 48.43 m^3 solid (1,710 ft^3) and hog fuel volume was 59.3 tonnes (65 tons) per hectare. Utilization of biomass was high with 93.6% of total available material being removed.

Productivity of the operation was affected by a number of factors. Proper directional felling of unmerchantable species was important to simplify the work of the chipper. A forwarder was used to collect felled trees in areas of low ground strength so the chipper would not get stuck. Use of the forwarder improved the overall productivity of the system.

Proper coordination of the trucking of wood chips with the chipper necessitated the development of a system of containers to store the chips between loads.

Moisture content in the wood had a significant effect on the chipper's productivity. In general, for a given species, the higher the moisture content the lower the productivity.

Technical Details:

Repap Miramichi Forest Products operates a 200,000 T.P.Y. kraft pulpmill in Newcastle, N.B. There are approximately 1,700 hectares (4,200 acres) of Crown land leased to the company within a 25 km (16 mi) radius of the mill. Much of this forest is of poor quality although it would have a high production capacity if properly planted; that is, the soil growth capacity is not being utilized at present.

The site chosen for the project was located 16 km (10 mi) from the mill. Using a manual shortwood system, all merchantable softwood trees were harvested. The remaining trees (i.e., trembling aspen, beech and maple) were directionally felled to facilitate processing by the chipper.

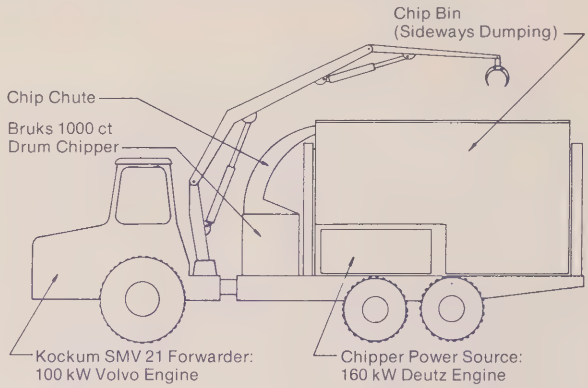
The chip harvester consists of a chipping unit, a 200 hp air-cooled Deutz diesel engine and a 17 m^3 (600 ft^3) chip bin mounted on a Kockum SMV21 forwarder chassis. The chipper, manufactured by Bruks Medaniska AB in Sweden, is a horizontally-fed drum unit which has a maximum tree diameter capacity of 40 cm (16 in). A loader mounted on the front chassis of the forwarder feeds the wood into the chipper's two hydraulically-driven feed rollers.

When the chip bin is full, the chipper travels to roadside and hydraulically lifts and tilts its load into a truck or container.

During the last nine weeks of the project, a brush forwarder was used in conjunction with the chipper. The forwarder was a Tree Farmer C6D with a 4.8 m (16 ft) bed and a bypass grapple. Although the load stakes were extended both horizontally and vertically to accommodate the largest possible load, the larger trees still had to be cut to 6 m (20 ft) lengths.

When the forwarder was in operation, the chipper would alternate between processing the wood the forwarder brought to roadside and working in the bush. A single truck was used to transport the wood chips to the mill. It was a tandem drive Ford, Model LT800 with a 34 m^3 (1,200 ft^3) dump box which could accommodate two full loads of the chip harvester. A subsequent project tested a system using 6 containers and a Hiab-Foca Svenska Forsaljnings AB model LV316 Load Exchanger which, by the addition of a trailer, could carry 2 containers at a time. This system lowered transportation costs and eliminated bottlenecks.

A total crew of 11 people was required to run the operation, although all are not continuously employed.



Integrated Chip Harvester

Economic Analysis:

Fuel Savings:

- Cost of producing 8,000 tonnes of wood chips is $233,780
- Cost of wood chips is $\frac{\$233{,}780}{8{,}000} = \$29.22$/tonne
- Value of oil displaced is 1.52 × $34.86 = $53.00/tonne*
- Thus, fuel savings are $53.00 – $29.22 = $23.78/tonne or $23.78 × 8,000 = $190,240 in total

*– 1 tonne of wood chips is the equivalent of 1.52 barrels of oil
– assumes cost of oil at $34.86 per barrel

Payback Period:

- Cost: $233,780
- Savings: $190,240 per year
- Payback period: 1.2 years

Other Savings:

- Savings in site preparation costs estimated @ $100/ha Thus 135 ha × $100 = $13,500
- Use of a container system for transportation reduced the cost per tonne by $3.00 to $26.22

Availability:

Integrated harvesting uses equipment available across the country.

The Bruks chipper was supplied by:

BDR Machinery
1104 Feuster Ave.
Mississauga, Ontario
L4W 2V7

Further Information:

For further information and a copy of the technical report, contact:

- ENEROPTIONS
  Energy Secretariat
  Government of New Brunswick
  P.O. Box 6000
  Fredericton, New Brunswick
  E3B 5H1
  (506) 453-3897

- Jan Ellingsen
  (re: ENEROPTIONS)
  Repap Miramichi Forest Products
  P.O. Box 5040
  Newcastle, New Brunswick
  E1V 3N3
  (506) 622-2250

Feasibility of a Wood Energy Industry in New Brunswick

Technology:
Economic analyses of the large-scale collection of forest and mill residues, the production of wood-chips, and their usage for residential, commercial and industrial heating.

Demonstration Project Managers:

Detailed Study: Doug Gorman
ADI Limited
1151 Regent Street
Fredericton, New Brunswick
E3B 3Z1

General Study: R.G. McKenna
Neill and Gunter Ltd.
P.O. Box 713
Fredericton, New Brunswick
E3B 5B4

Location:
South-central and eastern New Brunswick

Annual Savings:
Potential fuel savings of 11% to 30%

Payback Period:
Less than two years for firms engaging in the wood fuel supply industry

Applicable to:
- Suppliers of roundwood, green wood chips or hogged sawmill residues
- Residential, commercial and institutional buildings and industries currently using oil for heating
- Regions with existing forest industries and large cut-over areas

Description:
These two studies determined the availability of, and markets for, fuelwood in the areas of Kings and Queens Counties in south-central New Brunswick, and in the area around Newcastle in eastern New Brunswick, with the objective of determining whether a wood fuel industry could become viable. Both were feasibility studies and they showed that under a wide range of conditions profitable industries could be developed to sell semi-processed forms of wood fuel into markets located within about 50 km (30 mi) of the source.

The first study considered the supply of logging residues and assessed the potential for establishing various kinds of wood fuel operations that would produce more or less processed forms of fuel. Model industries were "built" on paper and profit statements were developed under varying supply/demand conditions.

The second study began with a detailed on-site survey of logging residues exclusively in a cut-over region, and went on to determine the methods and costs of producing chips from this material. The study also determined heating costs at schools, hospitals and industries of different sizes to determine the price of wood chips at which each would find it advantageous to convert from oil heating.

A side view of the Bruks chipping system.

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Benefits:

- Business opportunities were identified that would yield returns of:
  - — 65% per year on an investment of $416,000 for a firm supplying green wood chips;
  - — 71% on an investment of $647,000 for a firm supplying hogged sawmill residues;
  - — 77% on an investment of $265,000 for a firm supplying roundwood (split or whole).
- Improved rates of return and upgraded operations for firms currently selling merchantable timber.
- More stable operations in the face of varying demand and price levels.
- Displacement of up to 10 million L (2.2 million gals) of oil (light fuel oil equivalents) in Kings and Queens Counties and over 50 million L (11 million gals) of mainly heavy fuel oil in the Miramichi region.
- Employment generation at the site where the residues occur, in trucking them to markets, and at the point of use.
- Simplification of reforestation and reduction of fire hazards through the recovery of forest residues.

Economic Analysis (Kings and Queens Counties):

The Market

Wood fuels can replace oil used for heating. The wood energy market was estimated to be 11% of the existing oil market, or 49,450 bone dry tonnes (54,500 tons) per year. This estimate assumed that sales of residential wood stoves would continue at current rates and that aggressive marketing by the wood energy industry would convince 15% of the industrial/agricultural and 5% of the commercial/institutional users to convert to wood fuel heating.

The maximum price that sellers of wood fuel could charge was determined by calculating the costs to the user that would bring the present values of his or her savings from converting to wood fuel, minus the expenses of conversion, to zero, using interest rates of 15% or 20% and a system life of 10 years.

The Supply

Wood fuel can be obtained from two sources: residues from wood processing mills and biomass from the forest. Within the study area, ten mills were identified as potential sources of 69,433 bone dry tonnes (76,537 tons) per year of residues. The study area is almost completely covered with land classed as productive forest. The estimated recoverable forest biomass from this area is 115,875 bone dry tonnes (127,730 tons) a year. In total, the annual supply of biomass estimated to be available is nearly four times as large as the estimated demand. Production methods to bring this fuelwood from source to consumer could be based on delivery of any of the following products, each of which was modelled:

- green wood chips
- dried (to 20% moisture) wood chips
- hogged sawmill residues
- densified wood pellets
- split or whole roundwood in varying lengths.

Financial Analysis

The financial analysis indicates that green wood-chip, sawmill residue and fuelwood supply businesses are financially viable, but dried chips and pellets are not. The sawmill residue supply business has the highest return on investment of the various models because of the low cost for raw materials.

Each type of firm is sensitive to changes in sales prices for the product, as shown by a substantial increase in return on investment from the low price to the most likely price case study. However, there is a good margin of safety between the most likely sales prices and the minimum sales prices required to produce a 20% return on investment. The sales prices for wood chips, sawmill residues and fuelwood could drop by 18%, 50% and 17% respectively and still give an attractive return on investment. The different firms are much less sensitive to changes in sales volumes. In the most likely case, wood-chip, sawmill residue, and fuelwood sales could decrease by 54%, 64% and 48% respectively and still yield a 20% return on investment.

Economic Analysis (Miramichi Region):

The Market

It was estimated that a market could exist for 241,000 tonnes (265,650 tons) per year of forest residues (80% moisture content dry basis) if it could be delivered at competitive prices. This is far below the amount *physically* available, but not necessarily below the amount *economically* available. The size of the market was based on a survey of oil consumption in the schools, hospitals and industries of the region. These users generally have the high, stable demands that favour the conversion of oil-fired boilers to those capable of burning wood chips. Typical examples of a small school, large school, hospital and large industry were analysed to establish the price of wood chips at which conversion to burn wood fuel becomes economic. (Wood, even at zero cost, was not competitive with oil, for small industries.)

The Supply

Cut-over areas were listed and classified by cover type, cut age and volume. (Cuts older than five years were eliminated because of the decay of the residue.) Representative cuts were visited, and the amount of residue in each was measured by weighing material collected from sample plots. At this stage, four and five year old cuts were also eliminated because the average weight of material per hectare was only half of the 47 tonnes (52 tons) found on one year old cuts. The data showed that 46,875 oven-dry tonnes (51,670 tons) of residue material were available from each 1,000 hectares (2,470 acres) of cutover land. Assuming a harvest of 8,000 hectares (19,765 acres) a year, this would make available 375,000 tonnes (413,366 tons) per year.

Three production methods were examined to determine the cost of producing wood chips:

- the retrieval of branches, tree tops and standing residuals and their transportation to a cental site for chipping as a separate operation from the harvesting of merchantable wood;
- the chipping of branches, tops and trees brought to a cental processing site in conjunction with the harvest of merchantable timber;
- the harvesting of low-grade stands exclusively for fuel.

Using data from a number of sources the cost per km-tonne was calculated to be $7.02 ($7.74 per km-ton). This cost includes all operating and capital costs as well as a 15% profit. It was assumed that the chips would be transported by a 5-axle tractor trailer combination with a total carrying volume of 86.6 m^3 (3,058 ft^3).

Financial Analysis

Wood chips produced in whole-tree harvesting are generally fully competitive with oil, even with quite long truck hauls. However, cutting forest stands exclusively for wood chips is practical only if the users are small schools or if they are industries with existing wood-burning equipment or hospitals within a short distance of the source. Specifically:

- a small school could economically use wood chips produced in conjunction with harvesting merchantable timber or from stands of non-merchantable trees if they are trucked 50 km (30 mi) or less;
- a large school could economically use wood chips produced in conjunction with harvesting merchantable timber if they are trucked 5 km (3 mi) or less due to the assumptions of high capital cost and low load factor;
- a hospital could economically use wood chips produced in conjunction with harvesting merchantable timber if they are trucked 70 km (43 mi) or less or from stands of non-merchantable trees if they are trucked 40 km (25 mi) or less;
- a large industry with a wood-fired boiler in place could economically use wood chips produced in conjunction with the harvesting of merchantable timber if they are trucked 70 km (43 mi) or less.

With conventional methods, chips developed in separate clean-up operations are uneconomic except for small schools and for large industries with existing wood-burning equipment and located within 30 km (18 mi) of the fuel source.

Business and Labour Skills:

The business skills necessary to operate the wood energy industry are similar to those required for any small business. In addition, management personnel would require a thorough knowledge of the various components of the wood energy industry. These skills and knowledge are similar to those employed by sawlog and pulpwood harvesting contractors and sawmill operators.

Because the harvesting and processing of forest products is one of the major industries of New Brunswick, a wood fuel supply business would encounter no difficulties in obtaining the skilled and semi-skilled labour that it needs in that province. Some added training or upgrading will be necessary for oil burner mechanics who are not familiar with the installation and servicing of solid fuel combustion systems.

The wood energy industry could be established as an independent business or as an addition to an existing wood-related enterprise. The latter case is more attractive because it offers savings in overhead costs and improves the utilization of existing manpower and equipment. This is especially true if the new business is initiated by an independent wood-chip contractor operating at less than full capacity because of quota limits established by pulp mills.

Special Problems:

Several special problems must be resolved if barriers are not to arise and limit the development of a wood fuel industry. First, an inventory of wood fuels must be maintained at several points in the wood energy system in order to overcome seasonal differences in fuel supply and demand, to permit orderly and economic deliveries from the supply to the consumer, and to ensure a reliable and adequate supply of wood fuels during unexpected problem periods. The inventory points will be at the consumer, at the fuel processing location, and at the fuel source. Each of these locations will require a fuel storage volume and method which is specific to its function in the system.

Second, consumers who use wood chips and wood residue fuels will require all of the services that owners of an oil-fired furnace would need plus additional services that are particular to solid fuels. Typically, these would include a twice-yearly furnace and flue cleaning, maintenance insurance on the additional mechanical equipment associated with the fuel feeding system, and removal of the furnace ashes from the owner's property, possibly by the fuel supplier.

Third, although studies indicate that environmental impacts associated with the harvesting of residues are small compared with those of the original logging, excessive recovery could rob the soil of needed nutrients.

Finally, there is one area of concern related to the source materials. At present from both the economic and the silvicultural points of view, it would be desirable to develop wood fuel industries based on mill and logging residues. However, before long these residues could come to have higher value as industrial feedstock than as fuel.

Further Information:

For further information and a copy of either of the final reports, contact:

- ENEROPTIONS
  Government of New Brunswick
  P.O. Box 6000
  Fredericton, New Brunswick
  E3B 5H1
  (506) 453-3897

- Doug Gorman
  (re: ENEROPTIONS)
  ADI Limited
  1151 Regent Street
  Fredericton, New Brunswick
  E3B 3Z1
  (506) 454-4491

- R.G. McKenna
  (re: ENEROPTIONS)
  Neill and Gunter Ltd.
  P.O. Box 713
  Fredericton, New Brunswick
  E3B 5B4
  (506) 452-7000

Fuelwood Supply Evaluation

BONAVISTA PENINSULA, NEWFOUNDLAND

Technology:
A study of feasibility of establishing a wood fuel supply business

Demonstration Project Managers:
G. Veitch, W. Strong
Highlands Contracting Ltd.
P.O. Box 446
Gander, Newfoundland
A1V 1W8
(709) 651-3748

Location:
Bonavista Peninsula, Newfoundland

Annual Savings: 2.7 million litres (600,000 gallons) of fuel oil

Applicable to: Any area with fuel grade timber or sawmill waste and demand for heat.

Description:
An adequate and continuing supply of wood is essential in establishing a wood fuel supply business. This study reviews the situation in Newfoundland's Bonavista Peninsula to demonstrate how to assess the supply of wood from forests and sawmills and the cost of producing, delivering and storing wood chips for nearby markets. The study concluded that the projected demand for wood chips in the Bonavista Peninsula region is 15,000 green tonnes (16,535 tons) of chips per year, which would replace about 2.7 million L (600,000 gals) of oil (mainly light fuel oil used in commercial and industrial boilers). About 2,000 tonnes (2,200 tons) of chips would come from mill residues and the remainder from harvesting trees that are not otherwise merchantable. The rate of production from the forest is well below annual growth, so the harvest could continue in perpetuity. Average delivered costs would be $27.40 per green tonne ($24.85 per ton) or $49.81 per oven dried tonne ($45.18 per ton).

Benefits:
- 2.7 million L (600,000 gals) of fuel oil displaced by 15,000 green tonnes (16,535 tons) of chips per year. (About 25% of the biomass harvest would occur in the winter when unemployment is highest.);
- The creation of 12 new jobs;
- An increase in revenue to planer mill operations, which would increase the job security of workers at those mills.

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Method of Determining Supply:

The study began with an assessment of two potential fuelwood sources: mill residues and forest biomass. Mill residues are based on the lumber industry, which is the major user of the forests in the study area. There are over 500 licensed sawmills but only 40 produce more than 50,000 fbm per year, and they are dispersed throughout the region. Most of the residue from the sawmills is in the form of slabs and is already fully used for firewood close to the mills. However, planer mills in the area are concentrated around Goose Bay, and have an accumulated stock of clean residue amounting to 2,000 green tonnes (2,200 tons) which could be immediately chipped for fuelwood. In subsequent years, 1,000 to 2,000 tonnes (1,100 to 2,200 tons) could be chipped provided mill operators are willing to maintain clean stockpiles of residue unmixed with dirt and debris.

In selecting forest stands suitable for chipping, criteria had to be developed to minimize the loss of commercial sawlog and pulpwood stands to fuelwood harvesting. Apart from conventional criteria, such as accessibility, chipping should be considered as a use only for:

- Stands from which the merchantable component had been removed;
- Hardwood stands outside the hauling range of domestic cutters;
- Dense submerchantable softwood (rail type) stands in the mature to over mature age class;
- Damaged stands with no significant sawlog materials;
- Stands identified as existing or potential sources of domestic firewood.

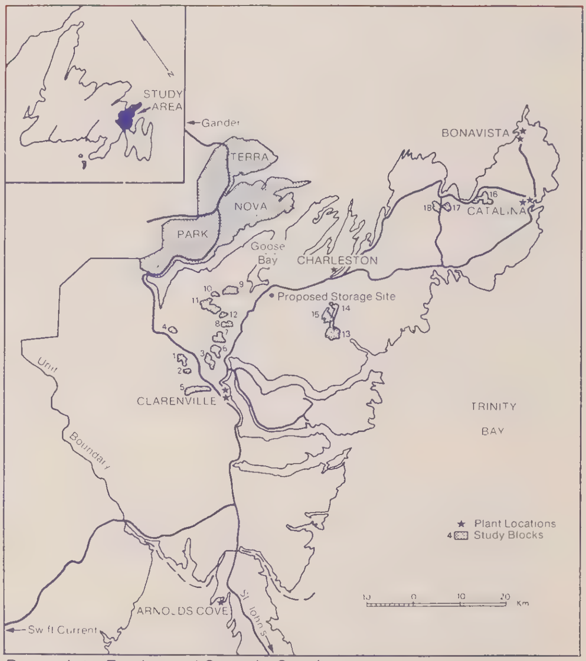
Using 1:30,000 forest type maps and the assistance of the management unit foresters, the stands were chosen, grouped into harvesting blocks and a haulroad network was identified. Only stands within an average hauling distance of 450 m (1,500 ft) from an existing roadside landing were considered, and those areas close to servicing roads (which are normally heavily picked over) were also excluded. Field checks were made to confirm the map data. For that portion of each stand identified for potential chipping, the following were determined:

- Average recoverable mass per unit area;
- Proportion of area recommended for integrated harvesting;
- Average mass recoverable per kilometre of new haul road.

The terrain, accessibility and location of each block were also assessed. Normally, the nature and location of the specific markets for chips would also enter into the final selection of harvesting areas, but, because this information was not available, the production plan was developed by concentrating harvesting over as limited an area as possible and by selecting sites which gave the best overall return.

Technical Details:

A review of possible production systems for the 12,000 to 13,000 green tonnes (13,200 to 14,300 tons) required from forest biomass indicated that central processing, which is capital intensive and provides little employment, was inappropriate for conditions in Newfoundland. Terrain chipping, widely used in Scandinavia but still unproven in Newfoundland, might be appropriate if tests prove successful. The remaining methods all involved roadside chipping. Given the relatively low capacity required (under 65 green tonnes (71 tons) per shift), possible choices of equipment for harvesting include only feller bunchers, short-wood forwarders, and grapple and choker wheeled skidders. This equipment can be used in a variety of combinations, but only manual felling with either a choker wheeled skidder or a grapple skidder were deemed to be low enough in cost and adequately proven in operations. The grapple skidder would be appropriate only at higher production rates.



Bonavista Fuelwood Supply Study

Economic Analysis:

Assuming a system producing 50 tonnes (55 tons) per 8-hour shift and using the manual fell/Timberjack choker skidder/14" Trelan chipper system (or equivalent), direct production costs for chips at roadside would amount to $12.70 per green tonne ($11.52 per ton). Adding indirect costs for road building, maintenance, snow clearing and overhead brings total production costs to just over $20 per tonne ($18 per ton). Transportation costs in a tandem pallet truck would average $9.14 per tonne ($8.29 per ton) based on 10 tonnes (11 tons) per load. In addition, central storage facilities for 1,000 tonnes (1,100 tons) of whole trees would be needed to allow for two months of downtime in the spring. Mill residues are estimated to cost $10 per green tonne ($9.00 per ton) in van; total costs after scaling/weighing and trucking would be $20.14 per tonne ($22.20 per ton). Adding forest biomass and sawmill residues to small-scale chipping by independent contractors yields 15,000 green tonnes (16,535 tons) and total costs of $410,895, or $27.40 per green tonne ($24.85 per ton). This calculation is based on 45% moisture content (established by experiment). On an oven-dried basis, tonnage would drop to 8,250 tonnes (9,094 tons) and costs would rise to $49.81 per oven-dried tonne ($45.19 per ton)

The portion of the wood-chip production harvested from the forest represents about 2% of the available volume of wood identified in the study. With regrowth, this rate of production (or a higher rate) could be maintained indefinitely into the future.

Availability:

The kinds of information developed in this study can be prepared by any consultant familiar with forest industry practices and the forest resource base in a local area.

Further Information:

For further information and a copy of the final technical report contact:

- ENEROPTIONS
  Energy Branch
  Department of Mines and Energy
  Government of Newfoundland and Labrador
  P.O. Box 4750
  St. John's, Newfoundland
  A1C 5T7
  (709) 576-2411

- Warren Strong
  (re: ENEROPTIONS)
  Highlands Contracting Ltd.
  P.O. Box 446
  Gander, Newfoundland
  A1V 1W8
  (709) 651-3748

ENEROPTIONS CASE STUDY

Whole Tree Chipping for Fuel

ABITIBI-PRICE PULP & PAPER MILL—NFLD.

Technology:
Harvesting, chipping, delivery and burning of hardwood.

Demonstration Project Manager:
Harvey G. Taylor
Production Superintendent
Abitibi-Price Pulp & Paper Mill
P.O. Box 500
Grand Falls, Newfoundland
A2A 2K1

Location:
Grand Falls, Newfoundland

Annual Savings: $187,400
(based on projection from 24 weeks operation) or $5.92 for each tonne of wood chips used.

Payback Period: 4.5 years

Applicable to:
Forest sector industries

Description:

This project evaluated a complete harvesting-chipping-transportation system for the burning of hardwoods for fuel as an alternative to Bunker C oil at the Abitibi-Price Pulp and Paper Mill in Grand Falls, Newfoundland. The trees in a nearby stand were felled manually and were hauled to a central landing by choker-rigged wheeled skidders. There they were chipped and loaded into modified dump trucks and tractor trailer vans for delivery to the newsprint mill.

The project resulted in an energy cost saving of $5.92/tonne ($5.37/ton) of wood chips and identified additional opportunities for system modification that could further increase cost savings in future operations.

Benefits:

- Energy costs were reduced by $86,491
- 13 jobs were created
- 16,071 barrels of oil were replaced by 14,610 tonnes (16,105 tons) of locally harvested wood chips.

Performance:

In 24 weeks of operation (7 days/week) the project produced 14,610 tonnes (16,105 tons) of chips, at a rate of 87 tonnes/day (96 tons/day) and a cost of $26.64 per tonne ($24.17/ton). When manual felling was replaced by a Hydro-AX feller-buncher the cost per tonne dropped but not enough to justify the extra cost of the equipment.

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Although the operation was profitable, the project manager concluded that a number of improvements could still be made. The use of choker skidders should be reconsidered because the mud and dirt which the trees accumulated as they were dragged along the ground by the skidders resulted in breakdowns of the chipper. The trucking system, which was responsible for 15% of the system's downtime, should be improved by the addition of a chip-van dumper at the mill.

Technical Details:

The harvesting took place in a 400 hectare (988 acre) hardwood stand composed mainly of white birch situated on slightly rolling terrain about 3 km (1.9 mi) from the mill. The average mean diameter of the harvested trees was 9.3 cm (3.7 in), well below merchantable size for pulpwood.

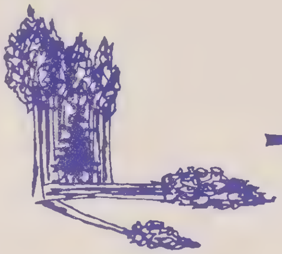
The project ran for 24 weeks, from June 29 to December 11, 1982. The equipment used was:

- A Morbark 22RXL total chip harvester with a Barko 160 hydraulic loader
- Three modified tandem dump trucks (White)
- Six choker wheeled skidders (Timberjack 230)
- Five Jonesered chainsaws
- One Hydro-Ax Model 411 B feller buncher

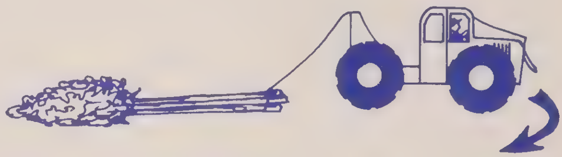
A crew of 13 worked on the project.

The chipper had to be modified by extending the main drive shaft and using a pillow block bearing to take the strain. This eliminated shaft and clutch breakages.

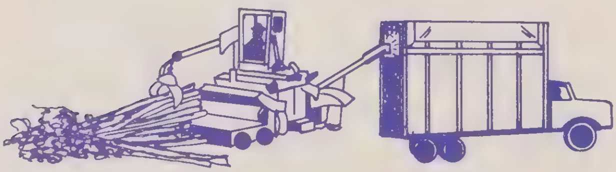
Mature birch stands



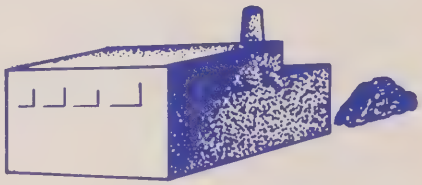
Manual felling



Cable skidding to roadside



Chipping into trucks



Stockpile at the mill

Economic Analysis:

Over a 24-week period:

- Cost of producing 14,610 tonnes (16,105 tons) of wood chips is $389,210
- Cost of wood chips is $\frac{\$389,210}{14,610} = 26.64$/tonne
- Value of oil displaced is 1.1 × $29.60 = $32.56/tonne*
- Thus, fuel savings are $32.56 – $26.64 = $5.92/tonne or $5.92 × 14,610 = $86,491 in total

*- 1 tonne of wood chips is the equivalent of 1.1 barrels of oil
- assumes an oil cost of $29.60 per barrel

Payback:

Cost: $389,210

Savings: $86,491

Payback Period: 4.5 years.

Availability:

The chipper was supplied by:
Morbark Industries
Box 1000
Winn, Michigan 48896
U.S.A.

Similar equipment is available across Canada.

Further Information:

For further information and a copy of the final technical report contact:

- ENEROPTIONS
  Department of Mines and Energy
  Government of Newfoundland and Labrador
  P.O. Box 4750
  St. John's, Newfoundland
  A1C 5T7
  (709) 737-2411

- Harvey G. Taylor
  (re: ENEROPTIONS)
  Production Superintendent
  Abitibi-Price Pulp & Paper Mill
  P.O. Box 500
  Grand Falls, Newfoundland
  A2A 2K1
  (709) 489-2201

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- ARCHITECTS
- UTILITIES

Copies of these materials are available from the offices listed overleaf.

ENEROPTIONS materials are available from:

National Office

ENEROPTIONS
Energy, Mines and Resources Canada
Box 4517
Station "E"
Ottawa, Ontario
K1S 5B5
(613) 995-9447

Newfoundland

- Energy Branch
  Department of Mines and Energy
  Government of Newfoundland and Labrador
  95 Bonaventure Ave.
  P.O. Box 4750
  St. John's, Newfoundland
  A1C 5T7
  (709) 737-2411
- Energy, Mines and Resources Canada
  Box 65, Atlantic Place
  3rd floor, Suite 301
  215 Water Street
  St. John's Newfoundland
  A1C 6C9
  St. John's: (709) 772-5353
  Elsewhere: Zenith 07792
  (toll free in province)

Nova Scotia

- Energy, Mines and Resources Canada
  Bank of Montreal Tower
  5th Floor, Suite 503
  5151 George Street
  Halifax, Nova Scotia
  B3J 1M5
  Halifax: (902) 426-8600
  Elsewhere: 1-426-8600
  (toll free in province)

New Brunswick

- Energy Secretariat
  Government of New Brunswick
  124 Saint John St.
  Box 6000
  Fredericton, New Brunswick
  E3B 5H1
  (506) 453-3897
- Energy, Mines and Resources Canada
  835 Champlain Street
  Dieppe, New Brunswick
  E1A 1P6
  Moncton: (506) 857-6070
  Elsewhere: 1-800-332-3908
  (toll free in province)

Prince Edward Island

- Energy, Mines and Resources Canada
  Brecken-Yates Bldg.
  Harbourside #1
  Charlottetown, P.E.I.
  C1A 8R4
  Charlottetown: (902) 566-7373
  Elsewhere: 1-566-7373
  (toll free in province)

Quebec

- Energy, Mines and Resources Canada
  Guy Favreau Complex
  200 Dorchester Blvd. West
  West Tower, 5th Fl. Rm 501
  Montreal, Quebec
  H2Z 1X4
  Montreal: (514) 283-5632
  Elsewhere: 1-800-361-2671
  (toll free in province)

Ontario

- Energy, Mines and Resources Canada
  55 St. Clair Avenue East
  Room 606, P.O. Box 2009
  Toronto, Ontario
  M4T 1M2
  Toronto: (416) 973-8480
  Elsewhere: 1-800-387-0733
  (toll free in province)

Manitoba

- Energy Information Centre
  Department of Energy and Mines
  Government of Manitoba
  117-234 Donald Street
  Winnipeg, Manitoba
  R3C 1M8
  (204) 945-4154
- Energy, Mines and Resources Canada
  Main Floor
  112 Osborne Street S.
  Winnipeg, Manitoba
  R3L 1Y5
  Winnipeg: (204) 949-4266
  Elsewhere: 1-800-542-8928
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Saskatchewan

- Energy, Mines and Resources Canada
  S.J. Cohen Building
  119 — 4th Avenue South
  Suite 706
  Saskatoon, Saskatchewan
  S7K 5X2
  Saskatoon: (306) 975-4532
  Elsewhere: 1-800-667-9712
  (toll free in province)

Alberta

- Energy, Mines and Resources Canada
  Grandin Park Plaza
  22 Sir Winston Churchill Ave.
  2nd Floor, Room 200
  St. Albert, Alberta
  T8N 1B4
  St. Albert: (403) 420-4035
  Elsewhere: 1-800-222-6477
  (toll free in province)

British Columbia

- Energy, Mines and Resources Canada
  Room 200, 100 West Pender St.
  Vancouver, B.C.
  V6B 1R8
  Vancouver: (604) 666-5863
  Elsewhere: 112-800-663-1280
  (toll free in province)

Northwest Territories

- Energy Conservation Division
  Department of Public Works and Highways
  Government of the Northwest Territories
  Yellowknife Centre, 5th floor
  Yellowknife, NWT
  X1A 2L9
  (403) 873-7203
- Energy, Mines and Resources Canada
  Precambrian Building
  10th Floor
  4922 — 52nd Street
  Box 68
  Yellowknife, N.W.T.
  X1A 2N1
  Yellowknife: (403) 920-8475
  Elsewhere: Zenith 06068
  (toll free in territory)

Yukon

- Energy Branch
  Department of Mines and Small Business
  Government of Yukon
  P.O. Box 2703
  Whitehorse, Yukon
  Y1A 2C6
  (403) 667-5382
- Energy, Mines and Resources Canada
  2078 — Second Avenue
  Whitehorse, Yukon
  Y1A 1B1
  Whitehorse: (403) 668-2828
  Elsewhere: Zenith 06068
  (toll free in territory)

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